Analysis of NGSO MSS Feeder Link Interference into Terrestrial Point-to-Point Links

FCC Draft Proposal No. 1/FL-MSS, MOD 2567(b) specifies a maximum power flux density (pfd) of -154 dB (W/m^2/4 kHz) for arrival angles between 0^0 and 5^0 for non-geostationary satellite downlinks operating between 6525-7075 MHz. This band overlaps the top 50 MHz of the FCC Part 21 Common Carrier and Part 94 Operational Fixed allocations in the 6525-6875 MHz band. The following calculations show the significant performance degradation of a single satellite interference into a high capacity 1-DS3 terrestrial point-to-point radio. Radio specifications are typical of products offered in the U.S.

The trend for U.S. radio manufacturers is to offer radios with higher spectral efficiency, employing advanced modulation methods like 64-QAM (quadrature amplitude modulation) and 128-TCM (trellis-coded modulation). This trend was further encouraged by the recent FCC rule changes in Part 21 and Part 94, which specify minimum spectral efficiency for all frequency bands between 4 and 11 GHz. Spectral efficiency requirements are generally more stringent in the U.S. than in other countries. Radios with higher spectral efficiency are more susceptible to satellite interference.

Example

Manufacturer:	Alcatel Network Systems	
Model:	MDR-4106c-CN	
FCC Identifier:	JF6-8609	
Capacity:	1-DS3	(digital)
Modulation:	64-QAM	
Bandwidth:	10 MHz	
Antenna:	12 foot parabolic	(3.7 meter diameter)
Misc. Losses:	2 dB	(feeder/branching)

Assume a co-channel interference into the MDR-4106c-CN, with no antenna discrimination, and a satellite transponder bandwidth of 16.3 mHz:

I = -154.0	dBW/m^2/4 kHz	Maximum Interference from the satellite
30.0	dB	Conversion from dBW to dBM
-124.0	dBM/m^2/4 kHz	
10.3	dB	Antenna area = 10 Log_{10}(PI x $(3.7/2)^2$)
-2.6	dB	Assume 55% parabolic efficiency = 10 Log_{10}(.55)
-116.3	dBM/ 4 kHz	
34.0	dBM/10 mHz	Noise Bandwidth ratio = 10 Log_{10}(10000/4)
- 82.3	dBM/10 mHz	
-2.0	dB	Feeder/branching losses
- 84.3	dBM/10 mHz	Interference level into the receiver in dBM

Assume that the terrestrial path has a 35 dB thermal fade margin to the 10^{-6} bit error rate receiver threshold. Most cellular providers and other microwave operators carrying data traffic normally use the 10^{-6} bit error rate threshold.

T	= -75.0 dBM	MDR-4106e-CN receiver threshold (10^{-6} bit error rate)
	35.0 dB	Thermal fade margin
C	= -40.0 dBM	Normal received signal level
I	= -84.3 dBM	Interfering power level from the satellite
C/I_1	= 44.3 dB	Carrier-to-Interference (co-channel)
C/I_2	= 24.0 dB	MDR-4106e-CN C/I for continuous 10^{-6} bit error rate
EIFM	= 20.3 dB	External Interference Fade Margin

FFM = $-10 \log_{10} (10^{-35/10} + 10^{-20.3/10})$ = 20.2 dB Flat Fade Margin

Threshold Degradation = 35 - 20.2 = 14.8 dB

Assuming that the effects of channel dispersion are insignificant, the multipath outage time without frequency or space diversity is:

$$T = R\,T_o \times 10^{-FFM/10}$$

where R is a function of path length, frequency, climate, and roughness and T_o depends on the length of the fading season. The performance degradation due to the interference is:

$$T_1 / T_2 = 10^{-FFM1/10} / 10^{-FFM2/10} = 10^{-20.2/10} / 10^{-35/10} = 30.2, \text{ or: } 3020\%$$

This percentage assumes that the satellite interference is received continuously during terrestrial fading events. The actual performance degradation will depend on the amount of time the terrestrial path is fading and receiving satellite interference, simultaneously. Some paths oriented along the satellite orbit will receive interference for large percentages of the time. Other paths oriented away from the orbit will be protected by antenna discrimination.

Paths affected by ground reflections, subrefractive fading, or other long-duration fading events will be particularly susceptible to satellite interference. These long-duration fading events may cause signal depressions of 20 dB or more for minutes (or hours). Satellite interference will reduce the effective fade margin of these paths, substantially increasing the probability of multipath outages. For example, paths in the southeastern United States are often affected by severe fading activity. Paths oriented in a north-south direction near the Gulf of Mexico will be exposed to interference from polar orbiting satellites as they clear the horizon over the Gulf.

Microwave operators demand very high path reliability (e.g., 99.999% or higher). The microwave paths in the 6 GHz band may be used by state and local governments for emergency communications, electric utilities to protect their transmission networks, gas pipeline operators to control pumping stations, or cellular operators to connect switching facilities to remote base stations. These microwave operators are not using fiber optics or other leased facilities because they cannot tolerate outages due to cable cuts or other service interruptions. Intermittent outages due to satellite interference are totally unacceptable to these users.

PCS providers have paid the Federal Government $7 billion for spectrum in the 1850-1990 MHz segment of the band, and need to relocate the incumbent 2 GHz microwave users to other bands in order to construct their networks. The 6 GHz band will be the most heavily used band for relocations, since it can support long path lengths, and is not affected by rain outage like the higher frequency bands. Under the FCC rules, PCS providers must provide comparable facilities to the 2 GHz microwave operators, or else they must pay to relocate the microwave operators back to 2 GHz. PCS providers will also use the 6 GHz band in their own networks for cell interconnects, particularly in suburban and rural areas. In the future, the 2110-2200 MHz segment of the band may be reallocated to MSS services. The incumbent microwave operators in this band may also require relocation to other bands.

ITU, in its document CPM95/118-E, discusses the sharing of spectrum between terrestrial fixed services and MSS feeder links. The document states that sharing should be done in lightly loaded terrestrial frequency bands. The 6 GHz band is heavily loaded now and will be even more heavily loaded when all 2 GHz relocations are performed, and cellular and PCS providers build out their networks.

<u>References</u>:

1. A. Vigants, "Space Diversity Engineering", Bell System Technical Journal, January 1975, pp. 103-142.

2. W. D. Rummler, "A Comparison of Calculated and Observed Performance of Digital Radio in the Presence of Interference", IEEE Transactions on Communications, July 1982, pp. 1693-1700.

Analysis of Interference between Terrestrial Point-to-Point Links and 4 GHz Geostationary Receive Earth Stations

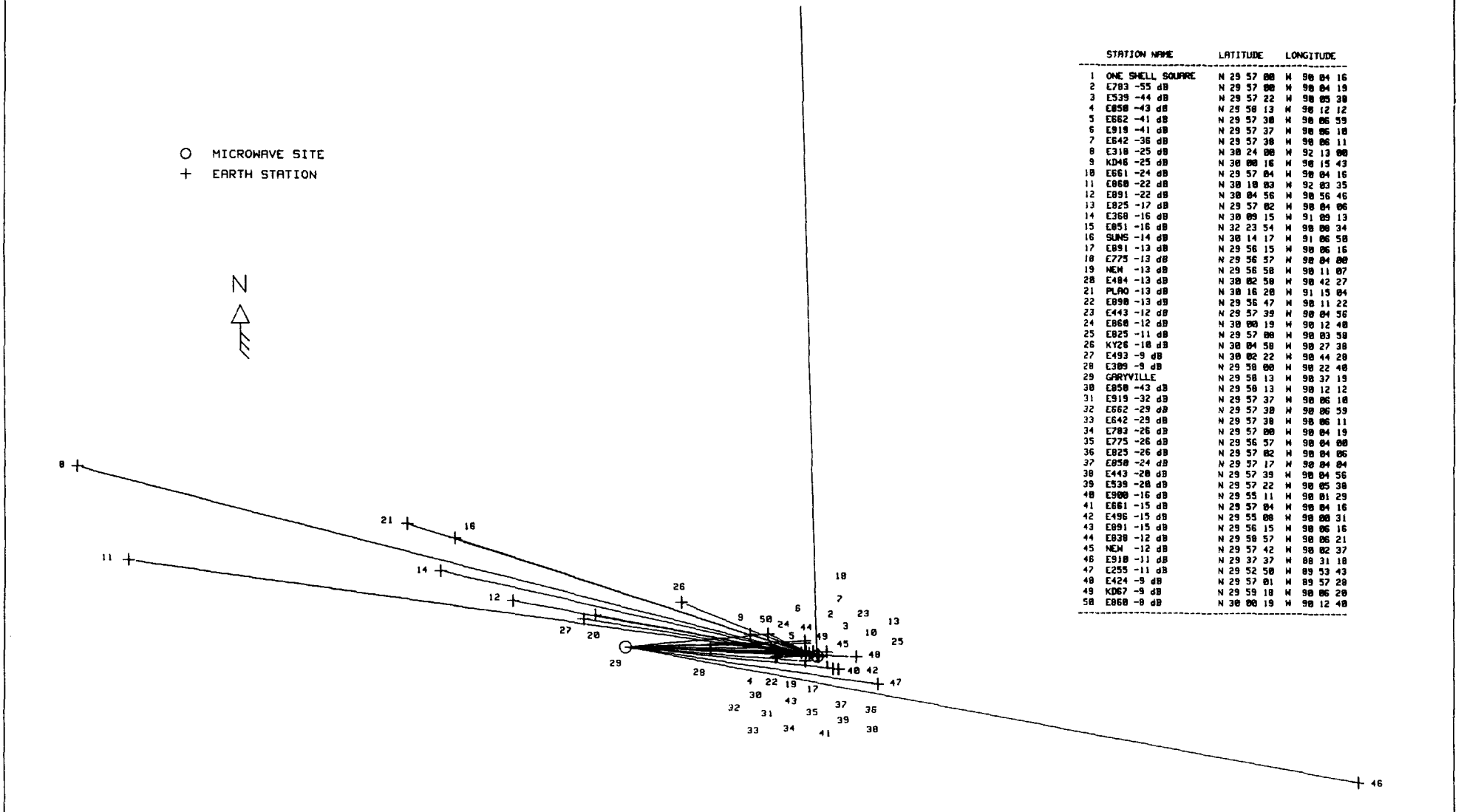
To demonstrate frequency coordination problems between terrestrial point-to-point systems and geostationary receive earth stations, Alcatel attempted to coordinate two 4 GHz terrestrial paths in typical metropolitan areas. New Orleans and Minneapolis were selected as test cities. The study was performed using the Comsearch frequency data base.

Figure 1 shows the results of the New Orleans coordination. The site locations and antenna heights of an existing lower 6 GHz microwave path from One Shell Square to Garyville were used for the test path, assuming 4 GHz antennas and radio equipment. A total of 48 interference cases were identified that exceeded the minimum earth station interference criteria. Each line on the plot shows an interference path. The table on the right lists the affected earth stations and the severity of each interference case in dB. The worst cases were 55 and 44 dB above the minimum acceptable interference.

Figure 2 shows the results of the Minneapolis coordination. An existing cellular path from Loretto to MTSO was used as the test path. The coordination identified 30 interference cases. The worst cases were 42 and 39 dB above the interference limit.

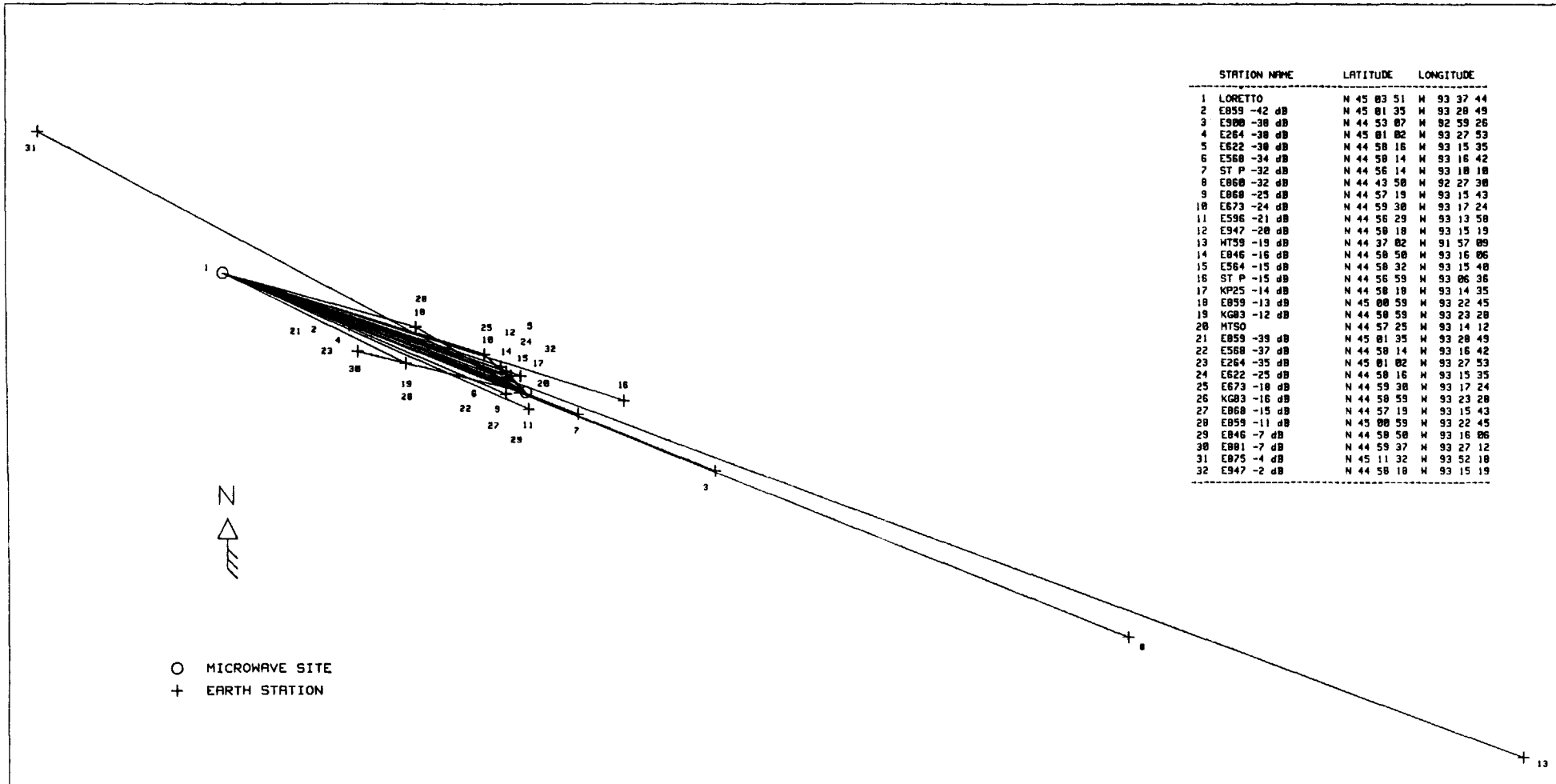
Alcatel's experience has been that it is virtually impossible to coordinate 4 GHz terrestrial paths in metropolitan areas in the U.S. To clear interference cases, it may be necessary to perform expensive field surveys to measure local shielding. Outside of metropolitan areas, microwave operators are reluctant to use 4 GHz due to the large number of unlicensed earth stations owned by consumers. Although the unlicensed earth stations are not protected against interference, owners tend to be very vocal about interference problems and may hold positions of authority in local governments, zoning boards, etc.

Alcatel is concerned that if the 11 GHz band is allocated to geostationary downlinks, the band may become unusable to point-to-point microwave (like the 4 GHz band). The 11 GHz band is the only other band besides lower 6 GHz with 30 MHz channels available, that can carry 2 or 3 DS3 capacity per RF carrier. The 11 GHz band is heavily used in metropolitan areas, when the lower 6 GHz band is unavailable due to frequency congestion. Higher bands like 18 GHz have excessive rain outage for these applications.



	STATION NAME	LATITUDE	LONGITUDE
1	ONE SHELL SQUARE	N 29 57 00	W 90 04 16
2	E703 -55 dB	N 29 57 00	W 90 04 19
3	E539 -44 dB	N 29 57 22	W 90 05 30
4	E850 -43 dB	N 29 50 13	W 90 12 12
5	E662 -41 dB	N 29 57 30	W 90 06 59
6	E910 -41 dB	N 29 57 37	W 90 06 10
7	E642 -36 dB	N 29 57 30	W 90 06 11
8	E310 -25 dB	N 30 24 00	W 92 13 00
9	KD46 -25 dB	N 30 00 16	W 90 15 43
10	E661 -24 dB	N 29 57 04	W 90 04 16
11	E860 -22 dB	N 30 10 03	W 92 03 35
12	E891 -22 dB	N 30 04 56	W 90 56 46
13	E825 -17 dB	N 29 57 02	W 90 04 06
14	E360 -16 dB	N 30 09 15	W 91 09 13
15	E851 -16 dB	N 32 23 54	W 90 00 34
16	SUNS -14 dB	N 30 14 17	W 91 06 50
17	E891 -13 dB	N 29 56 15	W 90 06 16
18	E775 -13 dB	N 29 56 57	W 90 04 00
19	NEW -13 dB	N 29 56 50	W 90 11 07
20	E484 -13 dB	N 30 02 50	W 90 42 27
21	PLAQ -13 dB	N 30 16 20	W 91 15 04
22	E898 -13 dB	N 29 56 47	W 90 11 22
23	E443 -12 dB	N 29 57 39	W 90 04 56
24	E868 -12 dB	N 30 00 19	W 90 12 40
25	E825 -11 dB	N 29 57 00	W 90 03 50
26	KY26 -10 dB	N 30 04 50	W 90 27 30
27	E493 -9 dB	N 30 02 22	W 90 44 20
28	E309 -9 dB	N 29 50 00	W 90 22 40
29	GARYVILLE	N 29 50 13	W 90 37 19
30	E850 -43 dB	N 29 50 13	W 90 12 12
31	E919 -32 dB	N 29 57 37	W 90 06 10
32	E662 -29 dB	N 29 57 30	W 90 06 59
33	E642 -29 dB	N 29 57 30	W 90 06 11
34	E703 -26 dB	N 29 57 00	W 90 04 19
35	E775 -26 dB	N 29 56 57	W 90 04 00
36	E825 -26 dB	N 29 57 02	W 90 04 06
37	E850 -24 dB	N 29 57 17	W 90 04 04
38	E443 -20 dB	N 29 57 39	W 90 04 56
39	E539 -20 dB	N 29 57 22	W 90 05 30
40	E900 -16 dB	N 29 55 11	W 90 01 29
41	E661 -15 dB	N 29 57 04	W 90 04 16
42	E496 -15 dB	N 29 55 00	W 90 00 31
43	E891 -15 dB	N 29 56 15	W 90 06 16
44	E838 -12 dB	N 29 50 57	W 90 06 21
45	NEW -12 dB	N 29 57 42	W 90 02 37
46	E910 -11 dB	N 29 37 37	W 88 31 10
47	E255 -11 dB	N 29 52 50	W 89 53 43
48	E424 -9 dB	N 29 57 01	W 89 57 20
49	KD67 -9 dB	N 29 59 10	W 90 06 20
50	E868 -8 dB	N 30 00 19	W 90 12 40

SATELLITE INTERFERENCE CASES
NEW ORLEANS METRO AREA
4 GHZ COMMON CARRIER BAND
KNIGHT/PROJECT/4GHZ_SATELLITE/RECORD-1
27 Apr 1995 HP-300



	STATION NAME	LATITUDE	LONGITUDE
1	LORETTO	N 45 03 51	W 93 37 44
2	E859 -42 dB	N 45 01 35	W 93 28 49
3	E900 -38 dB	N 44 53 07	W 92 59 26
4	E264 -38 dB	N 45 01 02	W 93 27 53
5	E622 -38 dB	N 44 58 16	W 93 15 35
6	E560 -34 dB	N 44 58 14	W 93 16 42
7	ST P -32 dB	N 44 56 14	W 93 18 18
8	E860 -32 dB	N 44 43 58	W 92 27 38
9	E868 -25 dB	N 44 57 19	W 93 15 43
10	E673 -24 dB	N 44 59 38	W 93 17 24
11	E596 -21 dB	N 44 56 29	W 93 13 58
12	E947 -20 dB	N 44 58 18	W 93 15 19
13	WTSS -19 dB	N 44 37 02	W 91 57 09
14	E846 -16 dB	N 44 58 58	W 93 16 06
15	E564 -15 dB	N 44 58 32	W 93 15 48
16	ST P -15 dB	N 44 56 59	W 93 06 36
17	KP25 -14 dB	N 44 58 18	W 93 14 35
18	E859 -13 dB	N 45 08 59	W 93 22 45
19	KG83 -12 dB	N 44 58 59	W 93 23 28
20	MTSO	N 44 57 25	W 93 14 12
21	E859 -39 dB	N 45 01 35	W 93 28 49
22	E568 -37 dB	N 44 58 14	W 93 16 42
23	E264 -35 dB	N 45 01 02	W 93 27 53
24	E622 -25 dB	N 44 58 16	W 93 15 35
25	E673 -18 dB	N 44 59 38	W 93 17 24
26	KG83 -16 dB	N 44 58 59	W 93 23 28
27	E868 -15 dB	N 44 57 19	W 93 15 43
28	E859 -11 dB	N 45 08 59	W 93 22 45
29	E846 -7 dB	N 44 58 58	W 93 16 06
30	E881 -7 dB	N 44 59 37	W 93 27 12
31	E875 -4 dB	N 45 11 32	W 93 52 18
32	E947 -2 dB	N 44 58 18	W 93 15 19

SATELLITE INTERFERENCE CASES
MINNEAPOLIS METRO AREA
4 GHZ COMMON CARRIER BAND
KNIGHT/PROJECT/4GHZ_SATELLITE/RECORD-2
27 Apr 1995 HP-300

Statistical Data for the 2 GHz Bands

Attached is a table listing the number of licensed microwave frequencies in the 2 GHz band. The table was taken from the FCC Office of Engineering and Technology report, "Creating New Technology Bands for Emerging Telecommunications Technology" (*OET/TS* 91-1). This document was used in the PCS proceeding to identify available frequency bands.

The following is a summary of the Part 21 Common Carrier and Part 94 Operational Fixed bands involved in the reallocation proceedings. Some or all of these systems may be relocated to other frequency bands in the future.

Frequency Band MHz	Service	Number of Frequencies
1850 - 1990	Part 94	9258
2110 - 2130 2160 - 2180	Part 21	6823
2130 - 2150 2180 - 2200	Part 94	13035
Total		29116

TABLE 1: STATISTICAL DATA FOR 2 GHz BANDS

BAND	RADIO SERVICE	LICENSEES	FACILITIES	CHANNEL BW	AVG. PATH LENGTH	Types of Uses	Sample Licensees
1850-1990 MHz Private Radio Services	Local Gov't. including Public Safety	168	2011	5 MHz 10 MHz	19.8 miles	Fixed Point to Point Control, Voice & Data	LA Sheriff, State of Florida, City of Dallas
	Petroleum	67	2487				Shell, Chevron, Exxon
	Power	164	3197				Georgia Power, Dairyland Power Cooperative, Interstate Power
	Railroads	18	895				Union Pacific, Burlington Northern, Missouri Pacific
	Others	143	668				Citibank, Hewlett-Packard, Procter and Gamble
1990-2110 MHz Broadcast Services	Broadcast Auxiliary	916	7359	17 MHz	30.4 miles (fixed)	Fixed and Mobile Broadcast Auxiliary - STL, ICR & ENG	ABC, CBS, NBC, Westinghouse
2110-2130/ 2160-2180 MHz Common Carrier Services	Telephone/ Cellular Paging	481	6823	3.5 MHz	17.9 miles	Fixed Point to Point Cellular cell tie ins & local telephone remote tie ins One-way Paging	Southwestern Bell, U.S West, McCaw, GTE
2130-2150/ 2180-2200 MHz Private Radio Services	Local Gov't. including Public Safety	549	4052	0.8 MHz 1.6 MHz	15.1 miles	Fixed Point to Point Control, Voice & Data	Commonwealth of Pennsylvania, State of California, Commonwealth of Virginia
	Petroleum	111	2933				Mobil, Amoco, Arco
	Power	258	3521				Pacific Gas and Electric, Southern California Edison, Allegheny Power
	Railroads	24	991				Atchison Topeka and Santa Fe Railway, CSX, Denver and Rio Grande Western
	Others	363	1538				Motorola, University of Maryland, Norstar bank
2150-2160 MHz Common Carrier Services	Multipoint Distribution	65	163	6 MHz	NA	Point to Multi-point Video Distribution (Wireless Cable)	Microband, Contemporary, Broadcast Data

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Preparation for International	)	IC Docket No. 94-31
Telecommunications Union World	)	
Radiocommunications Conferences	)	

To: The Commission

LATE FURTHER REPLY COMMENTS ON SECOND NOTICE OF INQUIRY

In the Second Notice of Inquiry for the above-captioned proceeding, the Commission proposes reallocating the upper 6 GHz (6.525-6.875 GHz), 11 GHz (10.7-11.7 GHz), and 18 GHz (17.7-19.7 GHz) bands to accommodate Non-Geostationary Mobile Satellite Service (NGSO MSS) feeder links. Under this proposal, terrestrial fixed microwave service ("FS") users, which have been allocated those bands on a primary basis, would be required to share them with NGSO MSS feeder links on a co-primary basis. As demonstrated in these Late Further Reply Comments, which are being filed to ensure a complete record in this proceeding, the Commission's proposal, if adopted, would have a disastrous impact on the FS industry and on the PCS industry.[1]

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[1]On May 8, 1955, the Commission published a NEWS Release that it had received the Final Report of its Industry Advisory Committee (IAC) on preparations for the 1995 World Radiocommunications Conference (WRC-95). The IAC's Final Report contains sections prepared by its six Informal Working Groups (IWGs). The section prepared by IWG-4 (dealing with MSS feeder links) was not concurred in its entirety by the parties filing these late Reply Comments because IWG-4 recommends sharing of the upper 6, 11 and 18 GHz bands..

In an attempt to reach an industry consensus on avoiding this problem, the FS interests have provided the NGSO MSS interests with a compromise plan, which is detailed herein. The FS industry hopes the NGSO MSS industry will look to the best interests of all wireless users and cooperate in resolving the spectrum sharing issues.

The upper 6, 11 and 18 GHz bands are allocated on a primary basis for FS. To clear spectrum for PCS, the Commission has required that FS users migrate from the 2 GHz band to bands above 3 GHz.

The upper 6 and 11 GHz bands, which already are acutely congested, will be prime location bands for the displaced 2 GHz FS users. Moreover, PCS licensees will use FS networks in the upper 6, 11 and 18 GHz bands to support their operations. If the upper 6, 11 and 18 GHz bands are reallocated on a co-primary basis for NGSO MSS feeder links, the following damage would occur:

- Approximately 30% of the upper 6 GHz band, which already is congested and which has been allocated for FS users being displaced to clear 2 GHz spectrum for PCS, effectively would be lost due to FS channel pairing requirements. This is especially critical because the Commission proposes allocating the 6825-6875 MHz band, and IWG-4 proposes allocating the 6650-6875 MHz bands, for NGSO MSS feeder links. Even though these already congested bands will be used by 2 GHz FS users clearing spectrum for PCS, there is no documented need that the same bands must be used for NGSO MSS feeder links.

- A comparable amount of the 11 GHz band, which also has been allocated for displaced 2 GHz FS users, likewise would be lost.

- The harmful interference from NGSO MSS feeder links to FS users, and significant decrease in usable spectrum, threaten public safety, utility and other FS users which require very high path reliability of 99.999% or higher.

In Reply Comments timely filed, the FS manufacturers and user interests, listed in the footnote below,[2] advised the Commission of these serious negative consequences that implementations on the proposed NGSO MSS feeder link reallocation would have on their industries.

In an attempt to resolve this problem, representatives of the FS and MSS interests met on May 3, 11, and 12, 1995 to discuss possible courses of action that would assist he Commission in finalizing U.S. proposals for WRC-95. The FS interests realize that the proposed reallocation of the upper 6, 11 and 18 GHz bands on a co-primary basis for NGSO MSS feeder links might be changed during WRC-95. Nonetheless, it is extremely critical that the Commission consider fully the potentially catastrophic impact that this proposed reallocation would have on both the FS and the PCS industries. Thus, the FS interests are filing a Statement of Non-Concurrence with IWG-4 reflecting this need for the U.S. delegation to address the impact on their industry and on the PCS industry during WRC-95.

In additional to the global allocation proposals for NGSO MSS to be considered at WRC-95, specific spectrum sharing issues for FS and NGSO MSS feeder links also must be considered by the Commission. These issues are relevant to the WRC-95 deliberations and will be

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[2]The parties to this filing are:
(a) Alcatel Network Systems Inc. (Alcatel)
(b) American Petroleum Institute (API)
(c) The Association Public-Safety Communications Officials International (APCO)
(d) Association of American Railroads (AAR)
(e) AT&T
(f) Harris Corporation - Farinon Division (Harris)
(g) Fixed Point-to-Point Communications Section, Network Equipment Division of the Telecommunications Industry Association (TIA)
(h) UTC, The Telecommunications Association (UTC)

especially relevant during any Commission rule making proceeding to adopt technical rules for NGSO MSS feeder link operations.

During the May 1995 industry meetings, the FS interests submitted several constructive, good faith compromise proposals to the NGSO MSS interests to solve the sharing problem. These proposals , which are set forth below, must serve as the platform for accommodating NGSO MSS feeder links in FS bands as WRC-95 and subsequent related Commission rule makings evolve. These proposals are:

1. The Commission has proposed that the 6825-7075 MHz band be allocated for NGSO MSS feeder links on a co-primary basis with FS, and the IWG-4 has recommended adding the 6650-6825 MHz band to this allocation for NGSO MSS feeder links (see attached diagram). The Commission is urged to oppose reallocation of the 6650-6825 MHz band for NGSO MSS feeder links because no demonstrated demand for this spectrum exists. Moreover, the United States proposals to the WRC-95 should advocate that only the spectrum for which there has been a demonstrated need should be made available for feeder links. The Commission is urged further to recommend that WRC-95 require that the 6875-7075 MHz band be totally utilized for NGSO MSS feeder links before the 6825-6875 MHz band (which is part of the upper 6 GHz band where 2 GHz FS licensees will relocate to open spectrum for PCS) could commence being used. If this recommendation for limiting availability of the 6650-6825 MHz band is not adopted, then the Commission should, in rules promulgated later for licensing of U.S. carriers to use NGSO MSS feeder links, include the foregoing limitation.

2. Satellite earth station receivers recognized are more susceptible to interference than comparable FS receivers. This difference unduly constrains the co-location of FS equipment near satellite earth stations. To remedy this imbalance, the Commission should plan to impose restrictions on the location and the number of NGSO MSS earth stations to ensure against harmful interference between such earth stations and FS facilities in the upper 6, 11 and 18 GHz bands. Specifically, the Commission should plan to restrict the

location of NGSO MSS earth stations to avoid densely populated areas and it should impose a maximum limit on the number of such earth stations that could be placed into operation in the U.S.

3. As an alternative to using the 6825-6875 MHz band for NGSO MSS feeder links, the Commission should evaluate the merits of the 12.7-13.25 GHz band.

4. The Commission should recognize that the criteria used under Part 25 of its Rules to calculate interference from satellite facilities into FS facilities are much less protective than the criteria under Parts 21 and 94 to protect FS facilities. For example, see FCC Rules Section 25.252 footnote 1 and Attachment B hereto.

5. The United States proposals to the ITU should not preclude the right of individual administrations to determine their own coordination criteria between terrestrial and satellite services.

6. The FS interests have offered to convene an industry working group with NGSO MSS interests to work on these technical proposals, while the WRC-95 process unfolds.

In conclusion, the Commission is urged most strongly to take these Further Reply Comments, although late, into account as it completes preparation of the U.S. proposals to WRC-95 and as it prepares technical rules for implementing these new allocations..

Respectfully submitted,

By: Leonard Robert Raish

Leonard Robert Raish
For the Convenience and on behalf of
FS manufacturers and Users[3]

Dated: May 15, 1995

cej/lrr/r#4/1C9431.plead

[3]See Footnote on page 1 for names of the FS manufacturers and users.